FROM THE

JOURNAL OF ANATOMY & PHYSIOLOGY

VOL XXII.

THE TONGUE

AND

GUSTATORY ORGANS OF FIBER ZIBETHICUS.

BY

FREDERICK TUCKERMAN, M.D.

AMHERST, MASSACHUSETTS.

Reprinted from the Journal of Anatomy and Physiology.

EDINBURGH:
PRINTED FOR THE AUTHOR BY NEILL AND COMPANY.

1888

THE TONGUE AND GUSTATORY ORGANS OF *FIBER ZIBETHICUS*.

By Frederick Tuckerman, M.D., *Amherst, Massachusetts.* (Plate VII.)

The tongue of this rodent was prepared for histological examination in the following way. The fresh organ was placed for twelve days in a mixture of 5 parts Müller's fluid and 1 part alcohol. It was then, after being washed for thirty-six hours in running water, transferred to ordinary spirit, where the hardening was completed. Subsequently it was divided into segments, which were embedded in celloidin according to the usual method.

General Account of the Tongue.—The shape of the organ suggests a division into an anterior and a raised posterior part. The two divisions are of about equal length. The length of the tongue from the base to the apex is 45 mm.

The anterior division is free from the floor of the mouth for 13 mm. or a little more than one-half its length. It measures 9·7 mm. in breadth and 6·5 mm. in thickness. Where it joins the posterior division (about the middle of the tongue) the breadth is 8 mm. and the thickness 8·2 mm. The upper surface is slightly convex anteriorly and flattened posteriorly, and is covered with fine small densely packed papillæ, the apices of which are directed backwards. A very well defined median groove, 12 mm. long, passes directly through the tip of the tongue, and is continued on to its under surface for a distance of 1 mm. Near the line of union of the anterior and posterior divisions there is a slight trace of a mesial groove running forwards along the anterior part for 6·5 mm. The apex is rounded and somewhat broad, and measures nearly 4 mm. in thickness. Papillæ of the fungi-

form type are not very numerous, and are limited to the anterior dorsal surface of this division. The under surface is perfectly smooth, and unmarked by any median raphé or groove save the one mentioned above.

The posterior division is 9·5 mm. in breadth and 11 mm. in thickness. The surface, which is a dark rusty-brown colour, is convex, and in front of the circumvallate papilla is covered with fine thickly placed papillæ, the points of which are directed backwards. The anterior extremity is elliptical in form, and is raised 2·5 mm. above the upper surface of the anterior division. At its lateral and anterior limits are scattered a number of large coarse dark-coloured papillæ. In the median line of the tongue, about 5 mm. from the base, is situated a single papilla of the circumvallate type. It measures across the upper surface 1 mm. The trench in which it ~~exists~~ does not completely encircle it, as anteriorly, for a breadth of 0·75 mm., it is attached to the surrounding parts.

On each side of the tongue, 6·5 mm. below the summit of the raised posterior part, and hardly discernible to the naked eye, is situated a papilla foliata. These papillæ lie imbedded in the organ, the crests of their ridges barely rising above the level of the surface. Each papilla measures 3 mm. in length, and its anterior extremity is 29 mm. from the tip of the tongue.

The Circumvallate Papilla.—The upper surface of this papilla is rounded, with nearly symmetrically sloping sides, and at its widest part is about 1·15 mm. in diameter. The sides are 0·45 mm. in length, and at their lower part bend inwards and downwards. The width of the trench is quite uniform in its upper half, becoming gradually narrower as it curves inwards at the base of the papilla. The upper angle of the outer wall of the trench is 0·15 mm. below the summit of the papilla. Serous glands are present within the papilla, but are mainly limited to its base. Both serous and mucous glands (the former being by far the more numerous) are very abundant in this region of the tongue. The ducts of the serous glands open into the bottom of the trench. At its upper part the papilla bears many secondary papillæ, both large and small, the depressions between which are filled by the epithelium.

At the lower part of the papilla, midway between its sides, is

a large ganglion[1] (0·3 mm. in diameter), the upper surface of which reaches the level of the middle of the papilla. It is surrounded by a very well defined connective tissue capsule, portions of which enter the body of the ganglion and give it support. Above and at the sides of the ganglion nerve fibres radiate outward towards the sloping side containing the taste-bulbs. The nerves are non-medullated, but possess a distinct primitive sheath, and their oval-shaped nuclei are clearly seen. The nerve cells are numerous, fairly uniform in size, and quite evenly distributed throughout the ganglion. They vary somewhat in shape, but are usually either oval or spherical. They contain large rounded or oval-shaped nuclei with granular contents.

The taste-bulbs are only fairly numerous in the circumvallate papilla. They are arranged along the side in a zone of five or six tiers, the upper tier not reaching to the level of the middle of the trench. In a horizontal section I counted sixty bulbs, which, if we allow for six tiers, will give approximately 360 bulbs for the papilla.

Taste-bulbs are also normally present (I found them in every section) in the lower third of the outer wall of the trench. Here they appear regularly arranged in a belt of three or four tiers (see fig. 1). In a horizontal section I counted forty bulbs, which, allowing for four tiers, would give 160 bulbs occurring in this region. If we add these to the 360 of the papilla, we shall have a total of 520 for this gustatory area. In several sections I found single bulbs situated in the epithelium of the papillary wall in its upper half, but failed to find them on the free upper surface.

The bulbs vary considerably in size and shape (fig. 2 shows the structure of the bulbs magnified 200 diameters). The average length is about 0·07 mm., and the average breadth about 0·04 mm. In some the neck is short, while in others it is long and narrow. I failed to find a bulb with hair-like processes protruding through the pore. The nuclei of the peripheral cells stain deeply in hæmatoxylin. The outer layer of

[1] Poulton has already called attention to the presence of a large ganglion in the circumvallate papilla of *Perameles nasuta*.—*Quart. Jour. of Micr. Sci.*, vol. xxiii., 1883, p. 73.

epithelium, at the point of its perforation by the bulbs, stains a uniform yellow in piero-carmine. By teasing I was enabled to isolate a bulb (see fig. 9) with a nerve fibril entering its base, and apparently continuous with the central process of a cell.

The Papillæ Foliatæ.—The exposed surfaces of these papillæ are somewhat flattened. The folds are very irregular, causing great inequality in the breadth of the ridges and depth of the furrows. Of the latter there are six present, but two of them are very shallow, and in some sections are absent altogether. The three main furrows are of about equal depth (0·25 mm.), and are fairly uniform in width. Serous glands are very abundant around the papillæ, and their ducts generally open at the bottom of the furrows. The body of each ridge carries at its upper part from two to five secondary ridges, the depression between them being filled by the epithelium.

The taste-bulbs are arranged three or four tiers deep along the sides of the folds or ridges at their lower part, the uppermost tier not usually extending above the level of the middle of the furrow. Frequently the bulbs form a continuous gland around the bottom of the furrow. I estimated the number of bulbs in each papilla (as shown by horizontal and vertical sections) at 400 or 800 bulbs for the two papillæ. These, added to the 520 of the circumvallate papilla, would give 1320 as the approximate total number of taste-bulbs contained in the gustatory organs proper of this tongue. The bulbs of this region are on the average a little smaller than those found in the circumvallate papilla.

The Fungiform Papillæ.—These papillæ are small and are thinly scattered over the anterior dorsal surface of the tongue. They are flattened on the top, their free surface being covered by a quite thick homogeneous layer of stratified pavement epithelium. Their sides are vertical, or nearly so, and they are surrounded by cone-shaped papillæ, the points of which overtop them by 0·05 to 0·10 mm.

Taste-bulbs are far from common on the fungiform papillæ of mammals. In this little animal I met with a few isolated ones occurring in the epithelium at the upper part of the papilla. The best example is shown in fig. 6. Here the bulb is placed vertically, directly in the axis of the papilla, with its apex

against the inner surface of the homogeneous layer of stratified epithelium, and its base penetrating the mucosa. It measures about 0·06 mm. in length and 0·03 mm. in breadth. It is of a higher type of bulb than I have usually found on these papillæ.

The papillæ of mechanical function covering the anterior division of the tongue are conical in shape, and are quite uniform in size and general arrangement. They are densely packed, there being about 170 to the square millimètre of surface. Their apices are bent slightly inwards and backwards. They are smallest and nearest together upon the sides, and gradually increase in size till they reach the upper surface of the dorsum. Their average height and breadth is 0·3 mm. and 0·065 mm. respectively, and the distance between them about 0·02 mm. Each one rests upon a papillary projection of the mucosa. The epithelium covering them is dense and imbricated, and in their upper half is completely cornified. The intervals between the papillæ at their base are filled for a short distance with epithelium, which also is imbricated in arrangement.

The cone-shaped papillæ investing the upper surface and sides of the raised posterior division do not differ in character very materially from those of the anterior division. They are less thickly placed in this region, there being about eighty to the square millimètre of surface. The apices are more pointed, and are directed inwards and backwards. The papillæ are a little broader and lower, and the epithelium covering them is imbricated and completely cornified in their upper half. Occasionally a papilla divides in its upper third, terminating in two spiniform processes. At the anterior extremity of this division are scattered a number of coarse brownish-black-coloured papillæ. Structurally, and aside from their size and the pigment granules which they contain, these do not differ essentially from those just described.

On the posterior surface of the epiglottis I found, in nearly every section, bulb-like structures embedded in the stratified epithelium. The two forms most frequently met with are shown in figs. 7 and 8. The former, the more common, measures 0·055 mm. in length and 0·04 mm. in breadth. The latter, of which I find comparatively few examples, measures 0·065 mm. in length and 0·03 mm. in breadth. In a number

of sections the apices of the bulbs reach the free surface of the epithelium. In a few instances their basal ends penetrate the mucous membrane to a considerable depth. I did not succeed in tracing nerve fibrils directly into the bulbs in this region.

EXPLANATION OF PLATE VII.

Fig. 1. × 25. Vertical section through the circumvallate papilla. *S.P.*, secondary papillæ; *t.*, the trench; *r.*, the ridge which surrounds the trench; *t.b.*, the taste-bulbs arranged in tiers; *t.b'.*, taste-bulbs situated in the epithelium of the outer wall of the trench; *t.b''.*, isolated taste-bulb; *gn.*, ganglion surrounded by its capsule; *gl.*, serous gland; *gl.d.*, the ducts of the serous glands, opening into the bottom of the trench; *m.m.*, mucous membrane.

Fig. 2. × 200. Vertical section through the base of the circumvallate papilla, showing the bottom of the trench and the five lowest tiers of taste-bulbs. *t.*, the trench; *t.b.*, taste-bulb, the reference mark indicating the basal end; *t.b'.*, taste-bulbs situated in the epithelium of the outer wall of the trench; *g.p.*, gustatory pore; *s.e.*, stratified epithelium; *o.l.*, outer layer of stratified epithelium; *gl.d.*, duct of serous gland; *m.m.*, mucous membrane.

Fig. 3. × 45. Transverse vertical section through one of the papillæ foliatæ. *fd.*, the folds of the papilla; *S.P.*, secondary papillæ; *f.*, the furrows between the folds; *t.b.*, the taste-bulbs embedded in the epithelium of the sides of the folds; *gl.*, serous gland; *gl.d.*, the ducts of the serous glands; *m.m.*, mucous membrane.

Fig. 4. × 95. Horizontal section through the base of one of the papillæ foliatæ, showing the sides of two opposed folds, with their taste-bulbs. *f.*, furrow; *t.b.*, taste-bulbs; *m.m.*, mucous membrane.

Fig. 5. × 45. Transverse vertical section through the anterior part of the tongue, showing the cone-shaped papillæ. *P.P.*, papillary projections of the mucous membrane entering each papilla; *s.e.*, stratified epithelium of ordinary structure between the papillæ; *m.m.*, mucous membrane.

Fig. 6. × 200. Vertical section through a fungiform papilla from the anterior part of the tongue. *t.b.*, taste-bulb; *P.P.*, papillary processes; *s.e.*, stratified epithelium.

Fig. 7. × 200. Transverse vertical section through the upper part of the posterior surface of the epiglottis. *f.s.*, free surface of the stratified pavement epithelium; *b*, bulb-like structure, lying partly in the epithelium and partly in the mucosa; *m.m.*, mucous membrane.

Fig. 8. × 200. Transverse vertical section through the middle of the posterior surface of the epiglottis. *f.s.*, free surface of the epithelium ; *d.l.*, deep layer of the epithelium ; *b.*, bulb with its neck and body embedded in the epithelium, and its rounded base resting in the mucosa ; *m.m.*, mucous membrane.

Fig. 9. × 240. Longitudinal section through a taste-bulb, showing direct continuity between the central process of one of its cells and a nerve fibril.

Fig. 1.

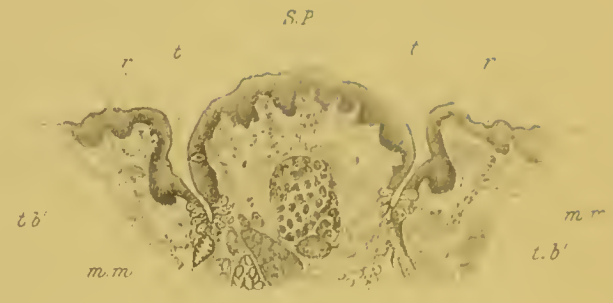


Fig. 3.

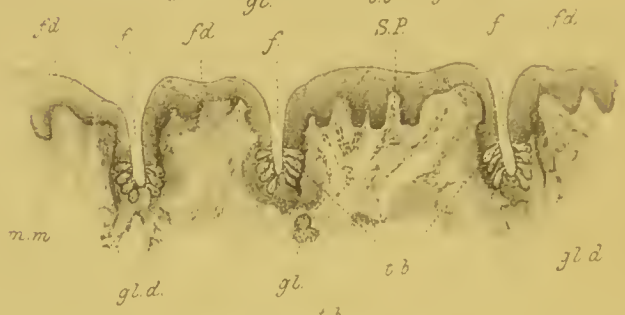


Fig. 6.

Fig. 7.

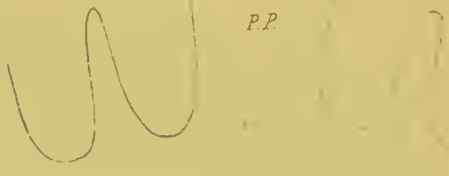
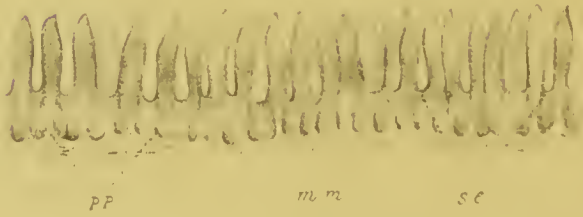


Fig. 8

Fig. 5.



K. I. Hall del

Fig. 2.

Fig. 4.

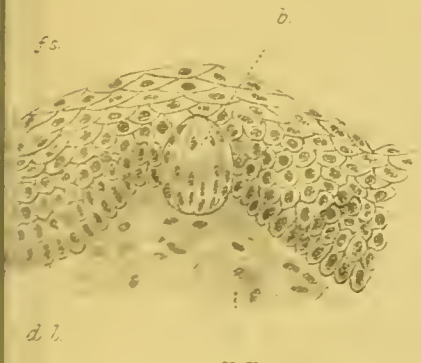
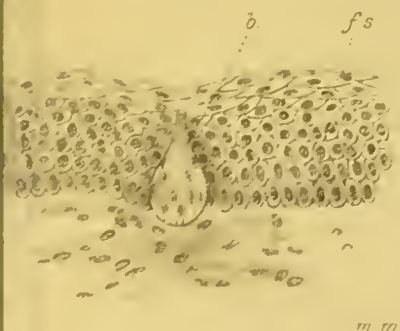


Fig. 9.



F Huth, Lith^r Edin^r

ER ZIBETHICUS.